LIGHTING DATA BULLETIN LD 147A

Lighting for Street Traffic Control

EDISON LAMP WORKS
OF GENERAL ELECTRIC COMPANY

GENERAL SALES OFFICE
HARRISON, N. J.

WELL LIGHTED AND PROPERLY LOCATED SAFETY ISLANDS SERVE TO DIRECT THE FLOW OF TRAFFIC IN THE PROPER CHANNELS

On Streets Used by Trolley Cars It Is Most Essential That Safety Islands Be Provided to Make a Success of Automatic Signalling. When These Safety Islands Are Used at Car Stops, Vehicular Traffic Can Pass by Stopped Street Cars Since Pedestrians Have a Safe Place to Stand. A Substantial Buffer Should Be Provided at The Oncoming Traffic End of These Islands and They Should Be Well Lighted so as to Be Clearly Visible.

Synopsis — Page

NOTE: The information contained in this bulletin supersedes that in the first 12 pages of bulletin LD 147—Lighting for Traffic Control. The other sections of this older bulletin covering Railroad Traffic and Marine Signalling are still up to date and will not be reprinted at present. Therefore LD 147 should be retained in the Lighting Data Bulletin series.

For information regarding Mazda lamps and lighting questions, refer to the nearest sales office.

To insure receipt of bulletins, notify the Department of Publicity, Edison Lamp Works of General Electric Company, Harrison, N. J., of any change of address.

NEW YORK'S FIFTH AVENUE TRAFFIC TOWERS ARE ORNAMENTAL AS WELL AS EFFECTIVE AND ARE ENTIRELY IN KEEPING WITH THE STORES ON THE AVENUE

Lighting For Street Traffic Control

Information Compiled by G. F. Prideaux, Engineering Department

Necessity for Traffic Control

The latest statistics show there are 19½ million motor vehicles registered and of course there are many more pedestrians. The congestion in cities resulting from large numbers of vehicles being forced to use narrow streets laid out long ago is paralyzing transportation facilities so vital to the prosperity of our country.

Many thousands of people are killed each year by automobiles. In 1924 over 19,000 deaths occurred through automobile accidents and 500,000 persons were seriously injured. The loss of life, personal injury and property damage from automobile accidents represents an economic waste of a minimum of 600 million dollars annually. In addition, congestion and inadequate traffic facilities cost the country over 2 billion dollars or about $20 per capita annually.

These data indicate quite clearly the great need of using every possible means to reduce the needless sacrifice of lives and the great waste caused by slowed-up transportation. It is an established fact that suitable traffic control will minimize these deaths and losses.

Effectiveness of Traffic Control

The National Automobile Chamber of Commerce recently conducted a survey of 36 cities on the effect of signal lights on traffic accidents. Twenty-nine of the cities reporting believe their use materially reduced accidents. Twenty-six of the cities reported the adoption of signal lights made possible increased volume of traffic. Considering an instance of the effect of proper traffic signalling we find that on Sixteenth Street, in Washington, D. C., before signal lights were installed it required an average of 7 minutes to travel a distance of 7000 feet. After the progressive system was installed the time to traverse this same distance was reduced to 3½ minutes at a speed of 22 miles per hour. Minneapolis, Detroit, Jackson (Michigan), New York and Chicago are other cities that report the running time on controlled streets has been reduced 20 to 50 per cent.

When the need for controlling traffic was first felt many cities assigned policemen to street intersections. With his hands and

arms the officer signalled traffic to stop and proceed. His effectiveness was limited due to the short range that his signals were visible, and the impossibility of having the various intersections on a definite cycle with either synchronized or progressive traffic movements. Often one officer, not knowing the traffic had been stopped at the next intersection, would send the traffic through his intersection. This action resulted in increased confusion. At times his signals were not entirely clear and people would proceed when they should not.

Electric signals properly installed and operated do not have these shortcomings. One-way signals mounted on the far side of the street, or pedestal or tower signals as they are sometimes called, have the necessary range of visibility. They can be operated in a synchronized or progressive system, depending on the way they are connected into the circuit, and they display unmistakable signals—a powerful red light for Stop and green light for Go.

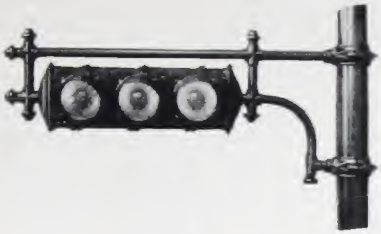
Cost of Traffic Control

If the intersections are controlled by officers, two shifts of men may be required per intersection. Assuming the officers are paid $1800 per year, the cost of controlling the intersection would be $3600 annually.

The cost of installing and maintaining electric signals will vary materially, depending on the type, method of wiring, cost of current, etc. An approximate figure of $150.00 per signal, or $600.00 per intersection per year, for the best type of equipment might be given. This is the figure that one power and light company charges one city where the complete installation, including initial investment, operation, maintenance of one-way bracket type signals, and control equipment for a progressive system, was made by the electric company. In this instance the investment charge is 31 per cent, based on amortization in five years.

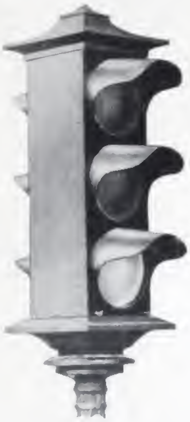
Manual Control

If an officer is used at an intersection to control traffic it is necessary to floodlight him at night to make his signals visible and to protect him from being struck by a vehicle whose driver does not see him. Floodlights have been designed for this purpose, one type of which is suspended directly over the officer and uses a 300- or 500-watt lamp. Or perhaps it may be preferred to mount



B

A



C

ONE WAY SIGNALS MOUNTED ON THE FAR SIDE OF THE STREET
ARE RECOMMENDED FOR INSTALLATION
WHEREVER POSSIBLE

A is the General Electric Vertical Bracket Type Signal; B is a General Electric Horizontal Bracket Signal; C is the Essco Post Type Signal. If Conditions Are Such as to Necessitate the Signal Being Located on the Near Side of the Street, Signals for Pedestrians Should Be Provided in the Back of the Housing as the Main Signal Beam Will Be Out of Their Range of Vision.

the floodlight on a nearby building or lighting pole, in which case a different type would be used.

Often the officer is supplied with a semaphore of the familiar Stop and Go type, which has an oil lantern on top with red and green lenses. The beam from this lantern is very feeble and the signal is practically ineffective unless it is properly floodlighted. The best arrangement is to have four floodlights directing their beams on it, one from each corner. However, two will serve very well if they are placed sufficiently high and on diagonally opposite corners.

A FLOODLIGHT SUSPENDED ABOVE THE OFFICER DIRECTING TRAFFIC WILL RENDER HIS SIGNALS VISIBLE AT NIGHT

Electrically lighted signals may also be manually controlled when desired, as is often the case at isolated intersections. The control box may be attached to the signal itself but is preferably located at the curb.

Automatic Control

There are three general types of automatic control for electric traffic signals. These are: 1—the synchronized system; 2—the progressive system; 3—the co-ordinated system.

When the synchronized system is used all the signals along the street display the same color; thus the North and South bound traffic moves while the East and West bound traffic stops, and vice versa. The synchronizing of the signals may be accomplished by having them interconnected by cable to a common or central

A B C

REFLECTOR TYPE PEDESTAL SIGNALS

These Signals Are Ornamental as Well as Effective. A—General Electric Signal; B—Essco Signal; C—Crouse-Hinds Signal. The 60-watt Traffic Signal Lamp Should Be Used in These Signals

control station, or by having the timing devices at each intersection operated by synchronous motors supplied with power from a common alternating-current supply.

The progressive system is a later development and apparently much more satisfactory. The lights of this system are staggered alternately red or green every block, or in groups of two or three blocks. When properly spaced and timed vehicles starting at the beginning of the street on the green light and traveling at a predetermined speed can travel through to the end of the street without stopping.

With the synchronized system installed we find numerous violations of speed laws and reckless driving. The driver often speeds up to 30 or more miles per hour to cover as much ground as possible before the lights change to red, forcing him to stop. In order to eliminate frequent starting and stopping the time between changes is rather long. Waiting for the green signal to come on is particularly irritating to a driver stopped at an intersection where the cross street traffic is very light or where there is no cross traffic at that particular time. It often leads to disobedience of the lights by motorists as well as pedestrians.

With the progressive system it does the motorist no good to speed, as he will only be stopped by the red light if he reaches the intersection before it turns to green, and he will make no better time than if he had travelled at the recommended speed. Cities having the progressive system installed report that it is very effective in preventing speeding and attending accidents. Further the time cycle at an intersection is very much shorter, and, if the motorist gets out of step with the system, or is just coming into it, he has only a very short wait before he can proceed in perfect time with the system. Pedestrians will more readily obey the signal if they do not have to wait so long before they can cross the intersection. Inasmuch as the pedestrian figures in a large number of traffic accidents this is an important factor.

The same control mechanism will operate the signals in a progressive system that operated them in a synchronous system. Synchronous systems in a number of cities are being changed over to progressive systems by simply changing the lamp connections in the alternate signals or alternate groups.

The co-ordinated system is similar to the progressive system in that it permits of continuous traffic movement, but it differs in

A B C

CONDENSER LENS TYPE SIGNALS

A—General Electric Signal; B—Horni Signal; C—Signal Made by Rochester Street Traffic Signal Company.

the respect that each intersection is independently controlled and may be differently timed. It is a further refinement of the progressive system in that it takes into account heavy or light traffic on cross streets and different length blocks. It requires, however, a different type of control apparatus.

The recommended size of signal lenses is $8\frac{3}{8}$ in. The Stop indication should be given through a red lens, and Go indication through a green lens, and the Caution indication through a yellow lens. In all vertically mounted signals, the red signal should be on top, the yellow in the center, and the green signal at the bottom. With the type of signal having a single lamp per four-way indication, this system cannot of course hold. The yellow lens should be in the center, however. If the signals are mounted horizontally the red signal should be in the outside position, the yellow signal in the center, and the green next to the curb or supporting post.

Right turns on the red signal should be prohibited as they tend to invalidate the positive stop command of the red indication. They further interfere with pedestrian traffic moving with vehicles and tend to force the cross traffic out of its normal lane, thereby causing accidents.

The indication recommended for fire control is a flashing red light, possibly accompanied by an audible signal.

Types of Signals

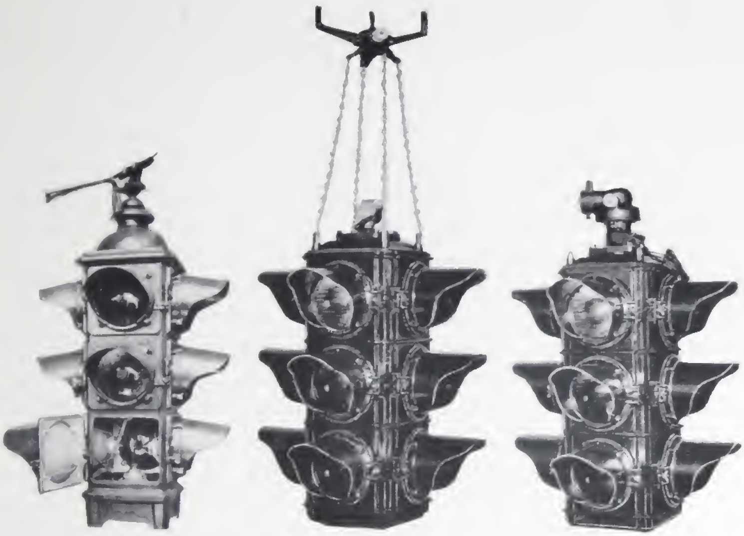
There are three general types of signals in use: 1—the bracket type; 2—the pedestal or tower type; 3—the suspended type.

The type recommended for installation wherever possible is the vertical bracket one-way signal with four signals to an intersection and located on the far side of the street, preferably within the curb line and with a height of about 10 feet to the lower lens.

The next in order of merit is the four-way pedestal signal mounted in the center or near the center of the intersection. This signal, when seven or eight feet above the road, has good visibility.

The horizontal bracket signal, which must be mounted higher than 14 feet 6 inches to comply with the laws in many states, may be missed by out-of-town motorists, whereas the pedestal signal would not.

The suspended type signal can be justified only in a synchronized system, since the driver need not look for indication on the signal directly overhead. He can look for the indication on the signals a



A B C

SUSPENDED SIGNALS OPERATE SATISFACTORILY IN A SYNCHRONIZED SYSTEM

A and B Are for Span Wire Suspension and Are Made by the General Electric Company and American Gas Accumulator Company, Respectively. C Is an A.G.A. Mast Arm Signal.

block or so down the street. With the progressive system, which is no doubt coming into general favor, the suspended type signal is not satisfactory, as the driver must watch for the signal at each intersection as he approaches it.

Optical Systems

There are two types of optical systems in general use in the electrically lighted traffic signal. These are the condenser type and the reflector type. The condenser type has one lamp located at the focal point of four lenses and gives a four-way indication. To obtain a satisfactory beam this type of signal should preferably be designed to use a 150-watt PS-25 clear MAZDA C lamp. A disadvantage of this arrangement is, however, that a lamp failure leaves one period of the cycle without an indication in any direction.

The reflector type (illustrated on page 9) has an individual lamp and reflector for each indication in the four directions. With this arrangement a lamp failure affects only one direction and the people coming from that direction can govern their actions by observing the traffic in the other directions. The reflector type system is about 20 per cent more efficient than the condenser type having four lenses for the same total wattage in each unit. In the one-way bracket signal, the reflector unit is particularly efficient because only a small amount of the total light given off by the lamp would be collected by one lens, whereas the reflector redirects a large amount. With the reflector type the 60-watt traffic signal MAZDA lamp is recommended.

The parabolic reflector and ordinary condensing lens project round beams which are not suitable, so that a spreading lens is used in addition to give the desired distribution of light. The requirements of light distribution are that sufficient light reach the pedestrians on the curbs, the eye of the vehicle driver stopped at the crossing, and the eye of the driver approaching the intersection. The particular beam pattern to do this will be different for each location of the signal; that is, the beam from a suspended unit at the center of the intersection will have to be different from a low mounted vertical bracket unit on the far side of the street, but in general should have a spread of about 90 degrees. If signals of the one-way type have to be mounted on the near side of the intersection to take care of some peculiar situation, auxiliary signals should be provided in the back of them, as it is obviously impossible

for the pedestrian wishing to cross the intersection to see the main beams from the signal.

Control Apparatus

The simplest control apparatus is of course possible with the manually controlled signal. Here all that is necessary is a suitable number of switches to change the signals at the officer's discretion.

If it is desired to operate a group of signals from one point this may be done by connecting all the lamp circuits to this one central

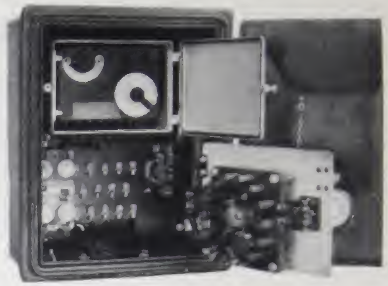
AUTOMATIC TRAFFIC CONTROL BOX MOUNTED ON PEDESTAL
Manual Control Handle in Operating Position.

point, where they may be either manually controlled or automatically controlled.

The driving mechanism, if automatically controlled, should permit of varying speeds so that the time of the cycle can be changed to accommodate traffic changes through the day, months and years.

If many signals are to be controlled from one central station the line losses and drops will be excessive, so in these cases relay

A



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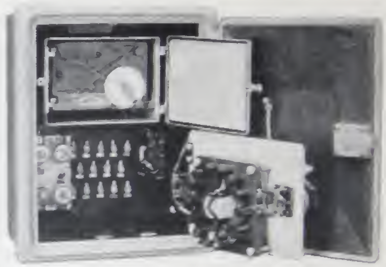


D

CONTROL APPARATUS

A—Manual Traffic Signal Control Switch. B—Induction Motor Timer Type of Automatic Control Box. A Group of Signals May Be Connected by Cable to This Control Box. Features of This Control Are: Automatic Control; Manual Control of Entire System From One Point; Flashing or Steady Amber Light; All Red or Emergency Signal For Entire System From One Point; Bell Control; Base Floodlight Control. C—Cascade Box for Connecting in Groups of Five Intersections to a Central Control System. D—Synchronous Motor Timer Type of Automatic Control Box. A Group of Signals Can Be Operated in a Synchronous or Progressive System Without Interconnecting Cables. Local Manual Control Flashing Amber, Emergency Signal, Bell Control, and Floodlight Control Are Also Provided.

boxes are placed near each group of signals and the current for lighting the lamps picked up locally. The current for operating the relays is supplied from the central control point.

In case it is not desired to interconnect the signals by cable and if alternating current is available from the same supply, synchronous motors can be used to drive the timing mechanism. Thus the signals will retain the same relationship with which they are initially set. These independent synchronous timers have the advantages of being able to take into account different length blocks and light or heavy cross traffic at the intersections which the interconnected signals cannot do. They have the disadvantage, however, of having a fixed time cycle when connected to the ordinary 60-cycle current. It is possible to overcome this by providing a special motor-generator set at one point and a two-wire cable from it to each intersection, to supply alternating current of any given frequency to the synchronous motors and hence change the time cycle by changing the frequency of the supply. This type of control is well adapted to the co-ordinated traffic system and is recommended for installation wherever possible.

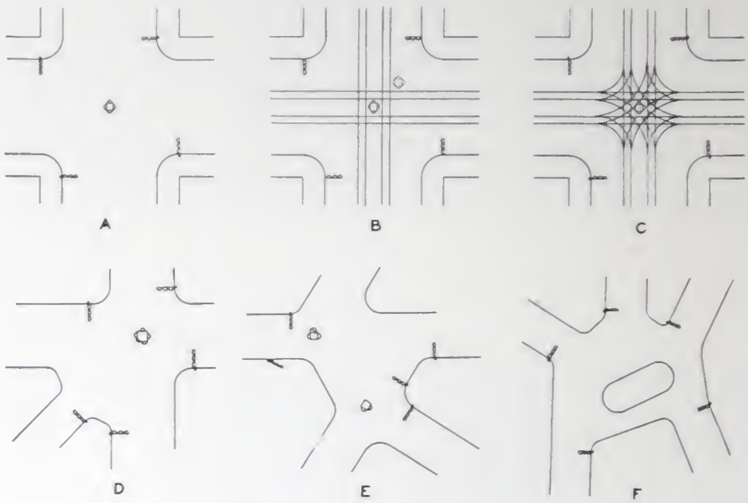
In addition to being automatically operated each intersection should be provided with a manual control which will cut out the automatic operation and permit the intersection to be controlled by an officer to handle unusual traffic situations, without interfering with the rest of the system.

Methods of Handling Typical Intersections

Inasmuch as it is very desirable to standardize traffic control systems, we are quoting and showing the methods recommended in the 1926 Progress Report of the National Highway Traffic Association's Committee on Electrical Traffic Signals at Intersections.

One-way signals on the far side of the street, if of the vertical bracket type and within the curb line, can be mounted at any height desired, but if they are of the horizontal bracket type they should be mounted more than 14½ feet high. Supended signals must be higher than 14½ feet in most states. Pedestal or post type signals can be any height desired.

Analyzing the types of signals, it will be seen that there is no condition that the one-way signal, mounted preferably on the far side of the street, but occasionally on the near side of the street,



(A) A REGULAR INTERSECTION WITHOUT CAR TRACKS

Four One-way Bracket Type on Far Side of Street, or One Four-way Post Type, or One Four-way Suspension Type

(B) REGULAR INTERSECTION WITH CAR TRACKS CROSSING BUT NOT TURNING

Four One-way Bracket Type on Far Side of Street, or One Four-way Post Type, or One Four-way Suspension Type.

(C) REGULAR INTERSECTION WITH CAR TRACKS CROSSING AND TURNING

Four One-way Bracket Type on Far Side of Street, or One Four-way Suspension Type.

(D) IRREGULAR FIVE-WAY INTERSECTION WITHOUT CAR TRACKS, AXES OF STREETS APPROXIMATELY INTERSECTING

Five One-way Bracket Type, Four on Far Side and One on Near Side of Street, or One Five-way Post Type.

(E) IRREGULAR INTERSECTION, AXES OF SEVERAL STREETS NOT INTERSECTING

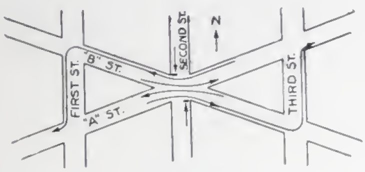
Five One-way Bracket Type, Four on Far Side, One on Near Side of Street, or Two Four-way Post Type Signals. Unnecessary Signals Blanked off.

(F) IRREGULAR INTERSECTION, AXES OF SEVERAL STREETS NOT INTERSECTING, OBSTRUCTION IN CENTER OF INTERSECTION

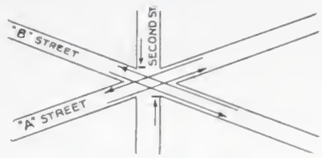
Five One-way Bracket Type Signals on Near Side of Street.

will not handle. There are conditions under which the four-way center signal is not practicable.

Uniformity is of great benefit and more effective observance of signals will be secured when the same type of signal is used throughout the city. If only a few isolated signals are used, it would be better to have them of post or pedestal type, if possible, but if there is a general effort to install signals at all intersections, some of which are very irregular, it would be well to install a system having the uniformity which may be secured by the use of one-way signals.



CORRECT



IMPRACTICAL

There is a peculiar type of intersection found in certain cities caused by diagonal streets crossing. Such intersections may occur at only one or two points within a synchronized controlled area and the correct way to handle them is shown.

When North and Southbound traffic is moving, the East and Westbound traffic on both the diagonal streets should be stopped. The Eastbound traffic on A Street comes to Second Street, bears right into B Street and turns North onto Third Street, and then, turning East on A Street, continues its journey. Westbound traffic on B Street should come to Second Street and then bear left onto A Street and continue its journey. Eastbound traffic on B Street should bear left at Second Street, and continue its journey on A Street. This is the only possible manner in which an irregular intersection of this type can be used as part of an interlocked system. Second and Third Streets may be close together, in which case the turning movement might be carried to Fourth or Fifth Street, barring left-hand turns at Third Street, if desired.

In the second half of this figure is shown an impracticable solution. When North and Southbound traffic is stopped, East and Westbound traffic on A Street and East and Westbound traffic on B Street must cross through each other at least four

times, and if these diagonal streets are heavily traveled, a dangerous situation arises.

Traffic Flow Guides

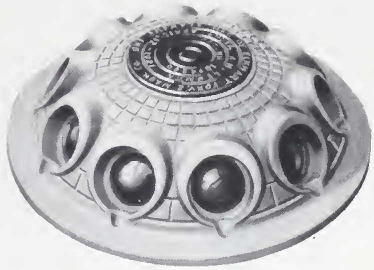
Pedestrian paths and traffic lanes for making right and left turns at intersections should be marked with guide lines. It is common practice to paint these white on the road surface or to use special prepared strips to stick to the surface. It is believed the most satisfactory method is to drive brass markers about 3 inches in diameter into the road, spacing them about a foot apart. These are much more permanent and more economical in the long run.

Traffic buttons of the mushroom type either lighted or unlighted are often used to guide the flow of traffic in the proper channels. If unlighted these markers should be of the reflector type to reflect the light from the car's headlamps. When placed at the entrance to the street about up to the curb line they are very effective in guiding traffic in the proper channel. On the left turn particularly, they force the driver to slow down and turn in the proper channel instead of cutting the corner at a high rate of speed, and intersecting the other traffic lanes at angles other than right angles, thereby causing great confusion. The light or reflection from these should be yellow when placed at the usual intersection. Two 50-watt A-19 inside frosted Mazda lamps or two 60-watt traffic signal Mazda lamps should be used to light them.

Traffic Beacons

There are many intersections in outlying districts that are dangerous due to the reduction in visibility by large buildings near the corners or to a considerable amount of traffic passing through. This traffic may not be heavy enough to warrant the installation of a control signal, or perhaps one of the streets is a boulevard or main avenue with through traffic, in which case it is advisable to have a warning beacon installed. The beacons may be installed in the street and serve in addition as traffic flow guides, or they may be mounted at the curb and serve simply as warning beacons. Many cities prefer to have the signals mounted at the curb, particularly when they are used to designate through streets. In this case two signals should be used, one on either side of the through street. When installed in the street, the beacons should be provided with two lamps so they will not be an unlighted obstruction in case of a lamp burning out. Of course, in either location

A



B

C

D

TRAFFIC FLOW GUIDES SERVE AS WARNING BEACONS AND TO DIRECT TRAFFIC IN PROPER CHANNELS

A is the Essco "Mushroom" Make; B is the Lehman Traffic Guide Made by The Elkhart Mfg. Company; C is a Guide Made by The Ohio Traffic Device Company; and D is a Reflecting Type Marker Made by The Universal Traffic Control Company. The Reflecting Lens Set in the Marker Appears Lighted When The Lights of an Approaching Car Shine On It. The Guides Shown in A, B, and C Are Lighted with Two 50- or 60-watt Lamps.

A B C

PEDESTAL TYPE FLASHING BEACONS OPERATED FROM THE LIGHTING CIRCUIT

The 60-watt Traffic Signal Lamp Will Light These Satisfactorily. The Lamp is Flashed With Reliable Motor-driven Flashers. The Reduction in Visibility Due to Their Installation is Minimum Due to the Four Pipe Support Construction. A is a General Electric Beacon. B is an Essco Beacon, and C is Made by Crouse-Hinds Company.

beacons may be operated from the lighting circuit or by separate batteries.

When the signal cannot be conveniently connected to power lines the battery most generally used is the wet cell or primary variety already widely applied for railroad signalling. After the batteries are exhausted renewal elements can be readily put in at a low cost. A set of these batteries will operate the signal lamps and flashers for six months to a year without attention.

THE 60-WATT MAZDA C STANDARD VOLTAGE TRAFFIC SIGNAL LAMP

Designed for Long Life and to Give Signals Adequate Brilliancy.

Special Features of Mazda Lamps for Traffic Signal Service

The new traffic signal lamps for standard voltages is a 60-watt, 110-120 volt, A-21 clear bulb Mazda C lamp. The filament is of the semi-concentrated type. The light center length is $2\frac{7}{16}$ in. The maximum overall length is $4\frac{7}{16}$ in. It is designed for horizontal or base down burning. As the bulb and light center length are short the lamp can be used in all installations where the 50-watt mill

A B C D

FLASHING BATTERY OPERATED ELECTRIC SIGNALS
ARE EFFECTIVE

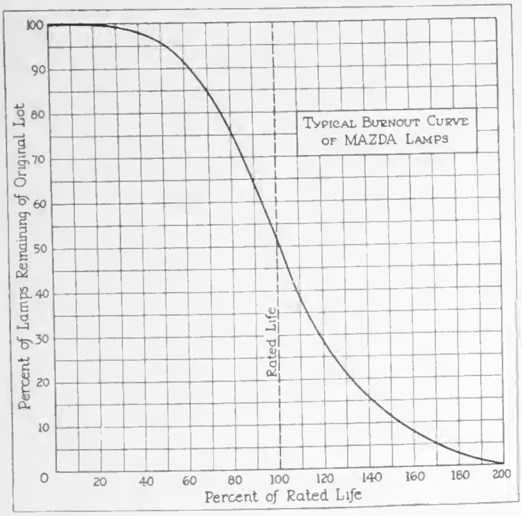
Recent Traffic Checks Made in a Large Western City on "Through Street Stop" Signals Showed the Traffic Crossing the Through Street Violated or Did Not Observe the Stop Signals as Follows:

On Non-illuminated Signals . .	60%
On Steady Burning Signals . .	47%
On Ever-Flashing Signals . . .	9%

A is the Welsbach Signal; B is the Adams Westlake Signal; C is the Essco Signal, and D is the Veco Signal.

type lamp was previously used. When used to replace the 50-watt mill type lamp it will give the signal approximately 50 per cent increased brightness for only a 20 per cent increase in wattage. The 60-watt traffic signal lamp is designed for 1500 hours life.

Other MAZDA lamps having extensive application to this service are the 50- and 150-watt sizes of regular MAZDA C lamps which are designed for 1000 hours life.



TYPICAL BURNOUT CURVE OF MAZDA LAMPS

If the Lamps are Renewed After They Have Burned 60 to 70 Per Cent of Their Rated Life Only About 10 or 15 Per Cent of the Lamps Will Have Failed Before This Time. This Will Insure Freedom of Signal Failures Due to Lamp Burnouts in the Majority of the Signals.

The battery operated beacons previously referred to use special low voltage lamps designed for such a life as to outlast the battery by about 30 per cent. It is recommended that these lamps be renewed at the time the battery is renewed rather than wait for the lamps to burn out. This practice assures greatest freedom from unlighted signals and greatest economy, as the cost of a new lamp is much less than the cost of a special trip out to replace a burned out lamp.

With any type of lamp, however, the life of an individual lamp cannot be definitely determined. A group of lamps will, if burned at their proper voltage, have an average life of approximately their rated life. Large numbers of tests show the failure of individual lamps from a group to be as shown in the curve on page 25. We see from this curve that, if we would be relatively free from the inconvenience and danger resulting from an unlighted signal, it is advisable to renew the lamps after they have burned about 60 to 70 per cent of their rated life.

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